

PATENT COOPERATION TREATY

PCT

**INTERNATIONAL PRELIMINARY
REPORT ON PATENTABILITY**
(Chapter II of the Patent Cooperation Treaty)
(PCT Article 36 and Rule 70)

Applicant's or agent's file reference FPI-12065	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/JP2004/016454	International filing date (<i>day/month/year</i>) 29.10.2004	Priority date (<i>day/month/year</i>) 30.01.2004	
<p>International Patent Classification (IPC) or national classification and IPC Int.Cl. H04N7/18 (2006.01) i, B60R1/00 (2006.01) i, B60R21/00 (2006.01) i, G06T1/00 (2006.01) i</p>			
<p>Applicant KABUSHIKI KAISHA TOYOTA JIDOSHOKKI</p>			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> a total of <u>7</u> sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			

Date of submission of the demand 21.11.2005	Date of completion of this report 02.08.2006	
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on:
 - the international application in the language in which it was filed
 - a translation of the international application into _____, which is the language of a translation furnished for the purposes of:
 - international search (Rules 12.3(a) and 23.1(b))
 - publication of the international application (Rule 12.4(a))
 - international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):
 - the international application as originally filed/furnished
 - the description:

pages 1-3, 5-18 as originally filed/furnished

pages* 4, 4/1 received by this Authority on 21.11.2005

pages* _____ received by this Authority on _____
 - the claims:

Nos. 3-8, 11-12 as originally filed/furnished

Nos.* _____ as amended (together with any statement) under Article 19

Nos.* 1, 9, 13-16 received by this Authority on 21.11.2005

Nos.* _____ received by this Authority on _____
 - the drawings:

sheets/figs 1-6 as originally filed/furnished

sheets/figs * _____ received by this Authority on _____

sheets/figs * _____ received by this Authority on _____
 - a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. The amendments have resulted in the cancellation of:
 - the description, pages _____
 - the claims, Nos. 2, 10
 - the drawings, sheets/figs _____
 - the sequence listing (*specify*): _____
 - any table(s) related to sequence listing (*specify*): _____

4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - the description, pages _____
 - the claims, Nos. _____
 - the drawings, sheets/figs _____
 - the sequence listing (*specify*): _____
 - any table(s) related to sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1, 3-9, 11-16	YES
	Claims _____	NO
Inventive step (IS)	Claims _____	YES
	Claims 1, 3-9, 11-16	NO
Industrial applicability (IA)	Claims 1, 3-9, 11-16	YES
	Claims _____	NO

2. Citations and explanations(Rule 70.7)

D1:JP 2001-187552 A (KABUSHIKI KAISYA TOYOTA JIDOUSHOKKI SEISAKUSYO)
2001.07.10

D2:JP 2004-004043 A (MATSUSHITA DENKISANGYOU KABUSHIKI KAISYA)
2004.01.08

D3:JP 2001-285681 A (MATSUSHITA DENKISANGYOU KABUSHIKI KAISYA)
2001.10.12

(claim1,3-9,11-16)

The technical feature [VIDEO IMAGE POSITIONAL RELATIONSHIP CORRECTION APPARATUS] in D1, the feature [CAMERA CORRECTOR] in D2 and the feature [CALIBRATION SYSTEM] in D3 are concerned with mutually related technical fields.

Therefore, the skilled person in the art would easily conceive the idea of employing the feature disclosed in lines 24-50 page 23, lines 01-29 page 24 in D2 or in lines 44-50 column 9, lines 35-37 column 10 in D3 to combine the feature in D1.

(claim1,9)

D1 discloses [the recognition means providing a virtual target and carrying out the recognition] (see lines 26-50 column 5, lines 1-21 column 6).

The skilled person would regards it as a design procedure to employ the technical feature [Values of the coordinate conversion parameters before modification are used as initial values of the coordinate conversion parameters]. Therefore the person skilled in the art would easily conceive the idea of employing the feature [a virtual target is one produced based on coordinate conversion parameters before modification].

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box No. V

(claim13,15)

D1 discloses [the recognition means automatically recognizes the nearest actual target] (see lines 3-8 column 6).

The skilled person would regard it as a normal option not to display the virtual target.

(claim14,16)

D1 discloses [lines extending between new virtual targets] (see lines 36-44 column13,fig 9).

The skilled person would regard it as a design procedure to employ the feature [lines extending between new virtual targets based on the coordinate conversion parameters after modification are displayed].

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of the relational expressions is larger than the number of the coordinate conversion parameters which require correction; the recognition means providing a virtual target in the monitor coordinate system on the monitor screen based on the coordinate conversion parameters before modification using the coordinate conversion means, and carrying out the recognition based on the difference between the monitor coordinate of the image of the actual target captured actually by the camera and the monitor coordinate of the virtual target.

According to the present invention, a steering assist apparatus includes the above video image positional relationship correction apparatus, in which the actual video image and the virtual video image are a video image at the back of the vehicle, and a steering assist guide, respectively.

Further, according to the present invention, a method of correcting relative positional relationship between an actual video image captured by a camera and a virtual video image when superimposing the actual image and the virtual video image on a monitor screen, includes the steps of: capturing actual targets in an actual coordinate system by the camera; theoretically deriving monitor coordinates in a monitor coordinate system on the monitor screen by coordinate conversion of actual coordinates of the actual targets in the actual coordinate system based on reference values of coordinate conversion parameters including internal parameters of the camera itself and attachment parameters for attaching the camera to the vehicle; providing a virtual target in the monitor coordinate system on the monitor screen based on the coordinate conversion parameters before modification and recognizing the monitor coordinates of the image of the actual targets actually captured by the camera based on the difference between the monitor coordinate of the image of the actual target captured actually by the camera

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and the corresponding monitor coordinate of the virtual target; generating relational expressions based on deviations between the monitor coordinates of the image of the actual targets and the monitor coordinates in the monitor coordinate system of the actual targets which have been subjected to coordinate conversion, the number of relational expressions being larger than the number of the coordinate conversion parameters to be corrected including at least internal parameters of the camera itself of the coordinate conversion parameters; correcting the coordinate conversion parameters such that the square-sum of the deviations is the minimum; and correcting relative positional relationship between the actual video image and the virtual video image based on the corrected values of the

CLAIMS

1. (amended) An apparatus for correcting relative positional relationship between an actual video image captured by a camera and a virtual video image for use in a video image display device for superimposing the actual video image and the virtual video image on a monitor screen, comprising:

actual targets set in an actual coordinate system in an area captured by the camera;

coordinate conversion means for theoretically deriving monitor coordinates in a monitor coordinate system on the monitor screen by coordinate conversion of actual coordinates of the actual targets in the actual coordinate system based on reference values of coordinate conversion parameters including internal parameters of the camera itself and attachment parameters for attaching the camera to the vehicle;

recognition means for recognizing the monitor coordinates of the image of the actual targets actually captured by the camera; and

correction means for correcting at least values of the internal parameters of the camera itself of the coordinate conversion parameters based on deviations between the monitor coordinates of the image of the actual targets actually captured by the camera and the corresponding monitor coordinates in the monitor coordinate system of the actual targets which has been subjected to the coordinate conversion, and correcting relative positional relationship between the actual video image and the virtual video image based on the corrected values of the coordinate conversion parameters,

the correction means generating relational expressions the number of which is larger than the number of the coordinate conversion parameters based on the monitor coordinates of the image of the actual

targets and the monitor coordinates in the monitor coordinate system of the actual targets which have been subjected to coordinate conversion, the coordinate conversion parameters being corrected such that the square-sum of the deviations is the minimum;

the number of actual targets being determined such that the number of the relational expressions is larger than the number of the coordinate conversion parameters which require correction,

the recognition means providing a virtual target in the monitor coordinate system on the monitor screen based on the coordinate conversion parameters before modification using the coordinate conversion means, and carrying out the recognition based on the difference between the monitor coordinate of the image of the actual target captured actually by the camera and the monitor coordinate of the virtual target.

2. (cancelled)

3. A video image positional relationship correction apparatus according to claim 2, wherein the recognition means includes a controller for moving one of the actual target and the virtual target on the monitor screen to a position overlapped on the other of the actual target and the virtual target by manipulation of an operator.

4. A video image positional relationship correction apparatus according to claim 3, wherein the controller includes direction buttons for inputting a correction amount of one of the actual target and the virtual target on the monitor screen in an up direction, a down direction, a left direction and a right direction, a decision button for confirming a condition in which the actual target and the virtual target are overlapped with each other, and a

calculation button for allowing the correction means to start correction calculation.

5. A video image positional relationship correction apparatus according to claim 1, wherein the recognition means includes an image processing circuit for carrying out the recognition by image processing.

6. A steering assist apparatus having a video image positional relationship correction apparatus according to claim 1, wherein the actual video image and the virtual video image are a video image at the back of the vehicle and a steering assist guide, respectively.

7. A steering assist apparatus according to claim 6, wherein the actual target is set on a road surface.

8. A steering assist apparatus according to claim 6, wherein the actual target is set on a planar member attached to a rear portion of the vehicle.

9. (amended) A method of correcting relative positional relationship between an actual video image captured by a camera and a virtual video image when superimposing the actual image and the virtual video image on a monitor screen, comprising the steps of:
capturing actual targets in an actual coordinate system by the camera;

theoretically deriving monitor coordinates in a monitor coordinate system on the monitor screen by coordinate conversion of actual coordinates of the actual targets in the actual coordinate system based on reference values of coordinate conversion parameters

including internal parameters of the camera itself and attachment parameters for attaching the camera to the vehicle;

providing a virtual target in the monitor coordinate system on the monitor screen based on the coordinate conversion parameters before modification and recognizing the monitor coordinates of the image of the actual targets actually captured by the camera based on the difference between the monitor coordinate of the image of the actual target captured actually by the camera and the corresponding monitor coordinate of the virtual target;

generating relational expressions based on deviations between the monitor coordinates of the image of the actual targets and the monitor coordinates in the monitor coordinate system of the actual targets which have been subjected to coordinate conversion, the number of relational expressions being larger than the number of the coordinate conversion parameters to be corrected including at least internal parameters of the camera itself of the coordinate conversion parameters;

correcting the coordinate conversion parameters such that the square-sum of the deviations is the minimum; and

correcting relative positional relationship between the actual video image and the virtual video image based on the corrected values of the coordinate conversion parameters.

10. (cancelled)

11. A method for the video image positional relationship correction according to claim 9, wherein the difference between the monitor coordinate of the image of the actual target and the corresponding monitor coordinate of the virtual target is calculated by moving one of the actual target and the virtual target to a position overlapped on the other of the actual target and the virtual target

on the monitor screen by manipulation of an operator.

12. A method for the video image positional relationship correction according to claim 9, wherein the monitor coordinates of the image of the actual targets are recognized by image processing.

13. (new) A video image positional relationship correction apparatus according to claim 1, wherein the recognition means automatically recognizes the nearest actual target to the virtual target without displaying the virtual target.

14. (new) A video image positional relationship correction apparatus according to claim 1, wherein the correction means calculates lines extending between new virtual targets based on the coordinate conversion parameters after modification, the lines being displayed on the monitor screen.

15. (new) A method for the video image positional relationship correction according to claim 9, wherein the nearest actual target to the virtual target is automatically recognized without displaying the virtual target.

16. (new) A method for the video image positional relationship correction according to claim 9, wherein lines extending between new virtual targets are calculated based on the coordinate conversion parameters after modification and displayed on the monitor screen.